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A47C 27/10

(52) UK CL (Edition L)
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GB 1341325 A GB 1162896 A EP 0275618 A
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UK CL (Edition L) A4M
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(71) Applicants
Kenneth Caldwell
Kingsway, Melplash, Bridport, Dorset, DT6 3UD, United Kingdom

Vera Caldwell
Kingsway, Melplash, Bridport, Dorset, DT6 3UD, United Kingdom

(72) Inventors
Kenneth Caldwell
Vera Caldwell

(74) Agent and/or Address for Service
Potts, Kerr & Co
15 Hamilton Square, Birkenhead, Merseyside, L41 6BR, United Kingdom

(54) Air support systems

(57) A force ventilated support system comprises an air-inflatable support means together with a forced ventilation means (see Figure 1), for ventilating the supported item.

There is also disclosed an air-inflatable support system comprising an air support means having a plurality of inflatable zones (see e.g. Figure 13) arranged horizontally or vertically.

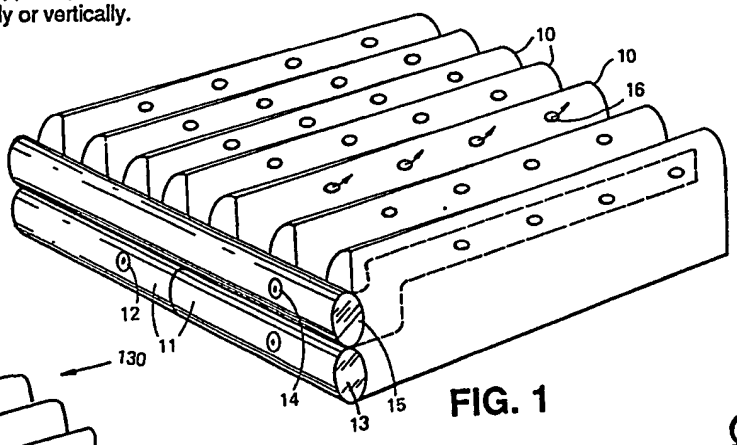

FIG. 1

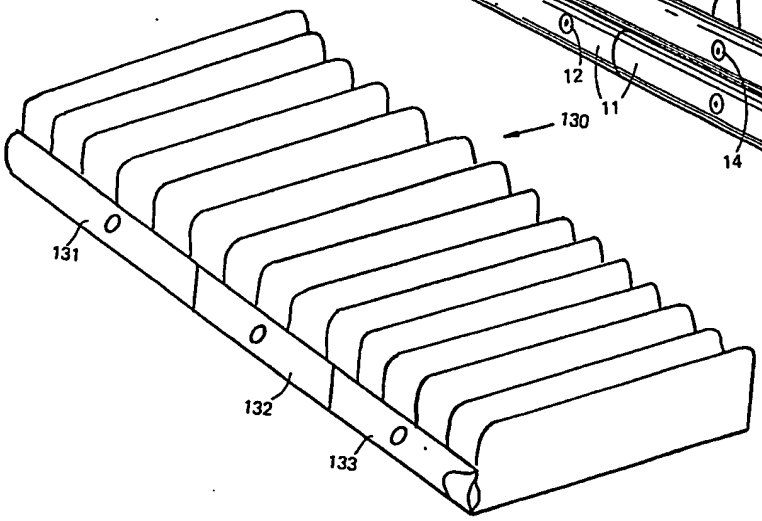

FIG. 13

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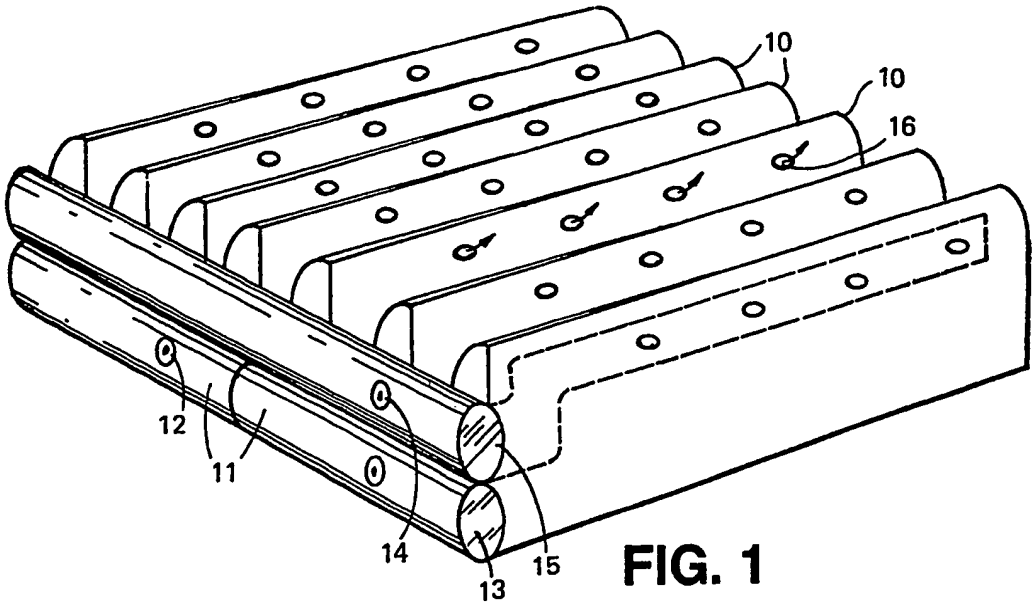


FIG. 1

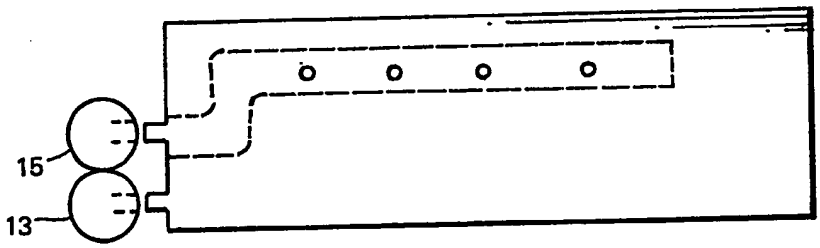


FIG. 2

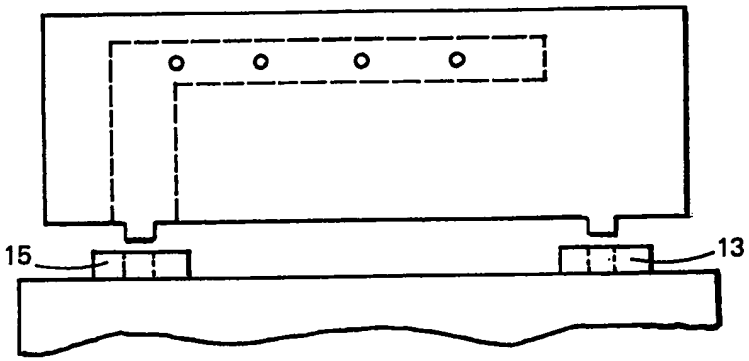


FIG. 3

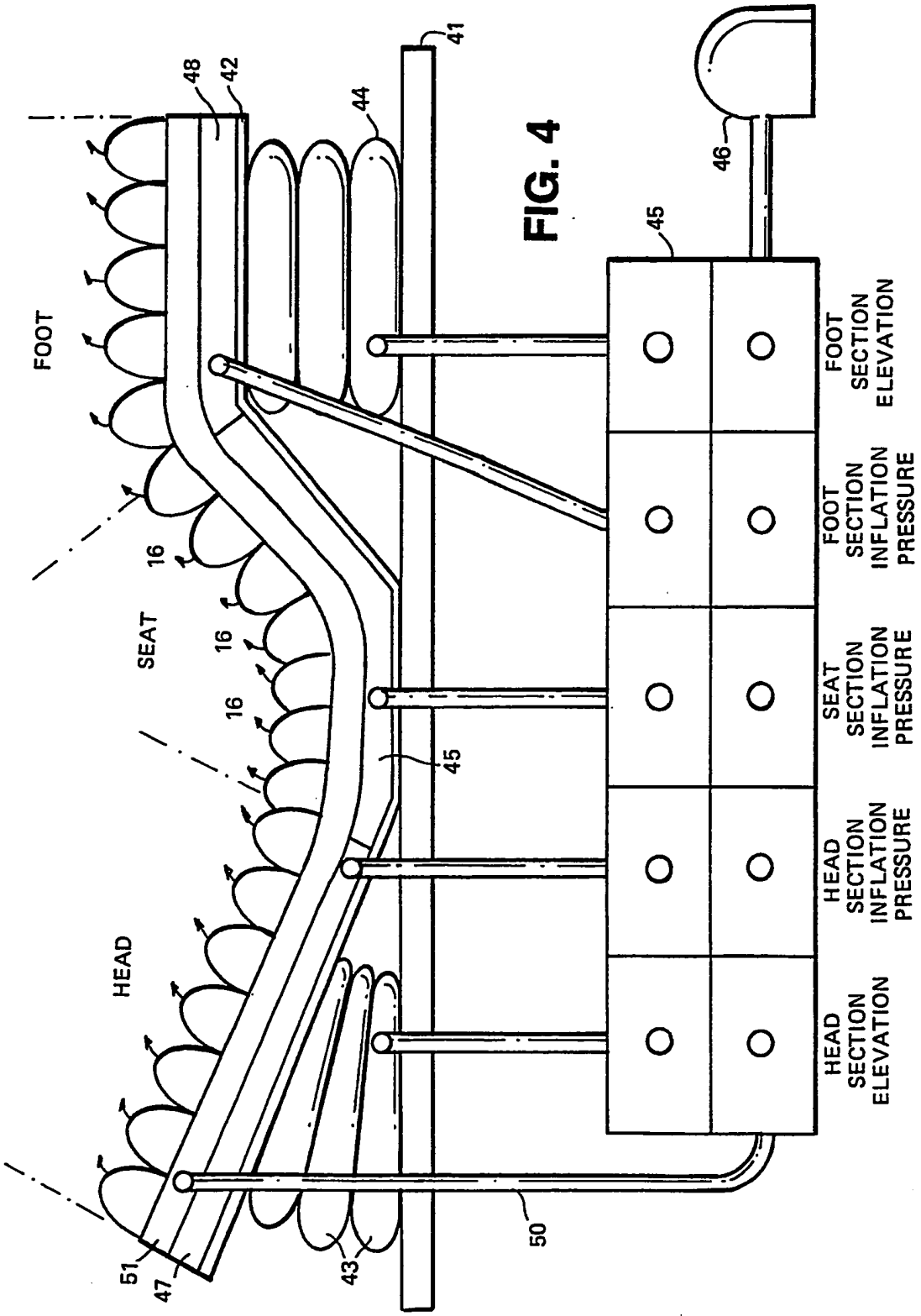

FOOT
HEAD
SEAT
16
16
16
48
42
44
41
46
45
45
50
51
47
43
FOOT SECTION ELEVATION
FOOT SECTION INFLATION PRESSURE
SEAT SECTION INFLATION PRESSURE
HEAD SECTION INFLATION PRESSURE
HEAD SECTION ELEVATION

FIG. 4

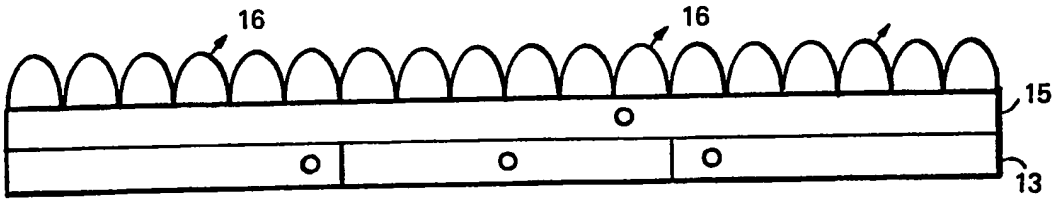
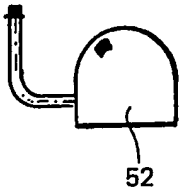
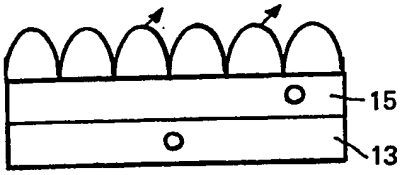


FIG. 5





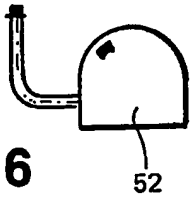


FIG. 6

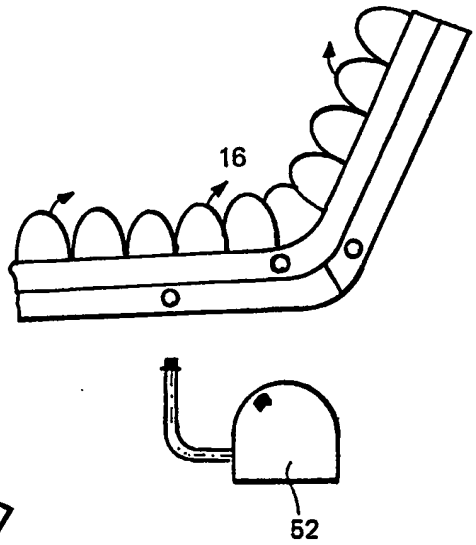


FIG. 7

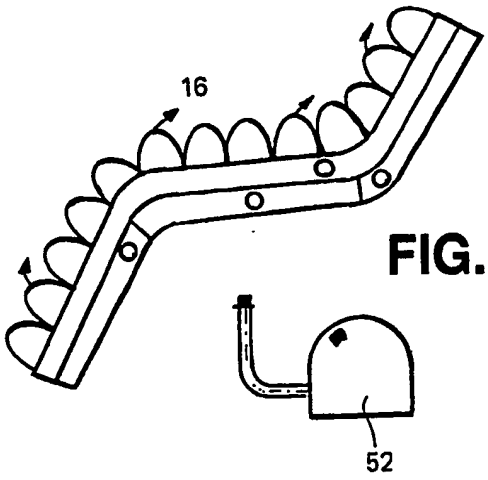


FIG. 8

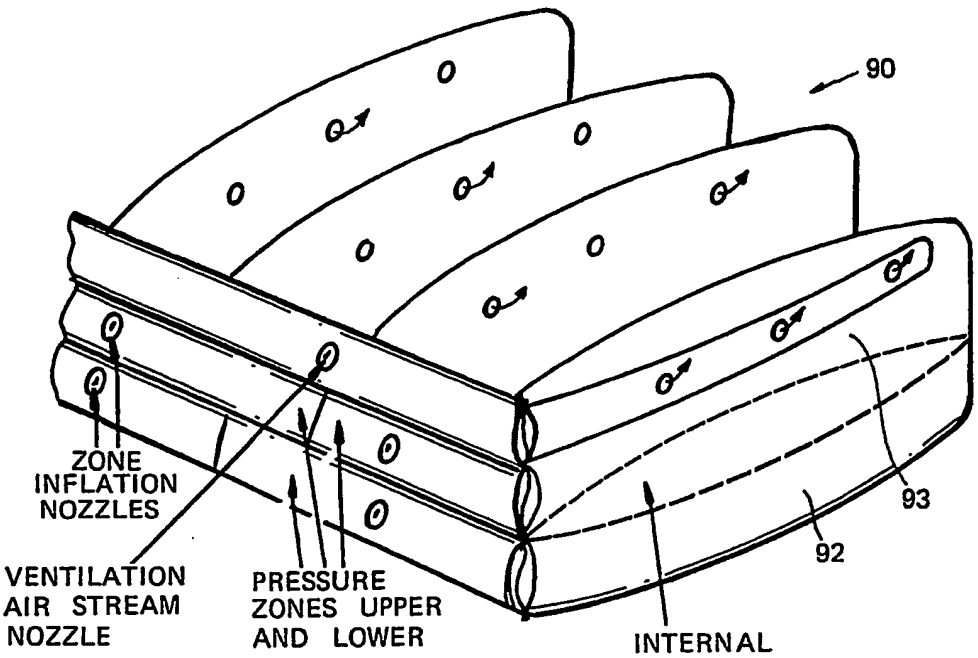


FIG. 9

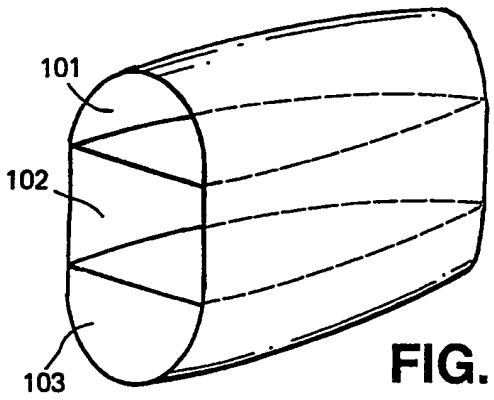


FIG. 10

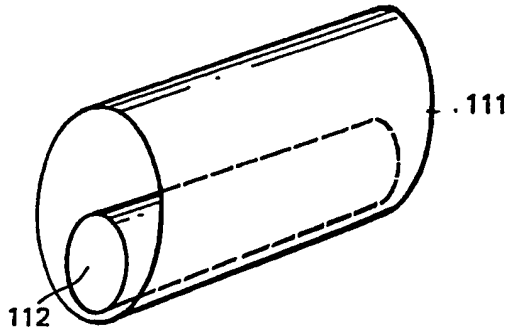


FIG. 11

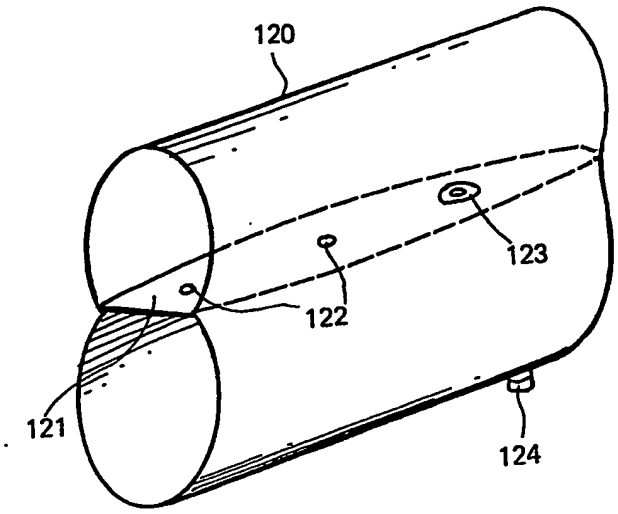


FIG. 12

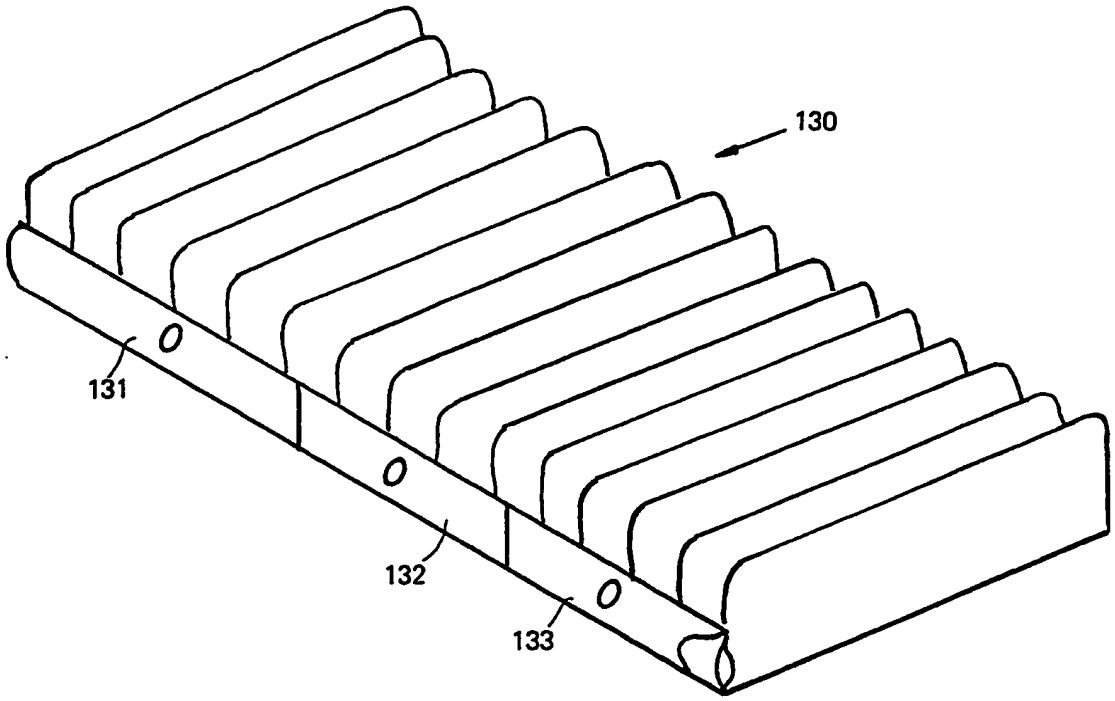


FIG. 13

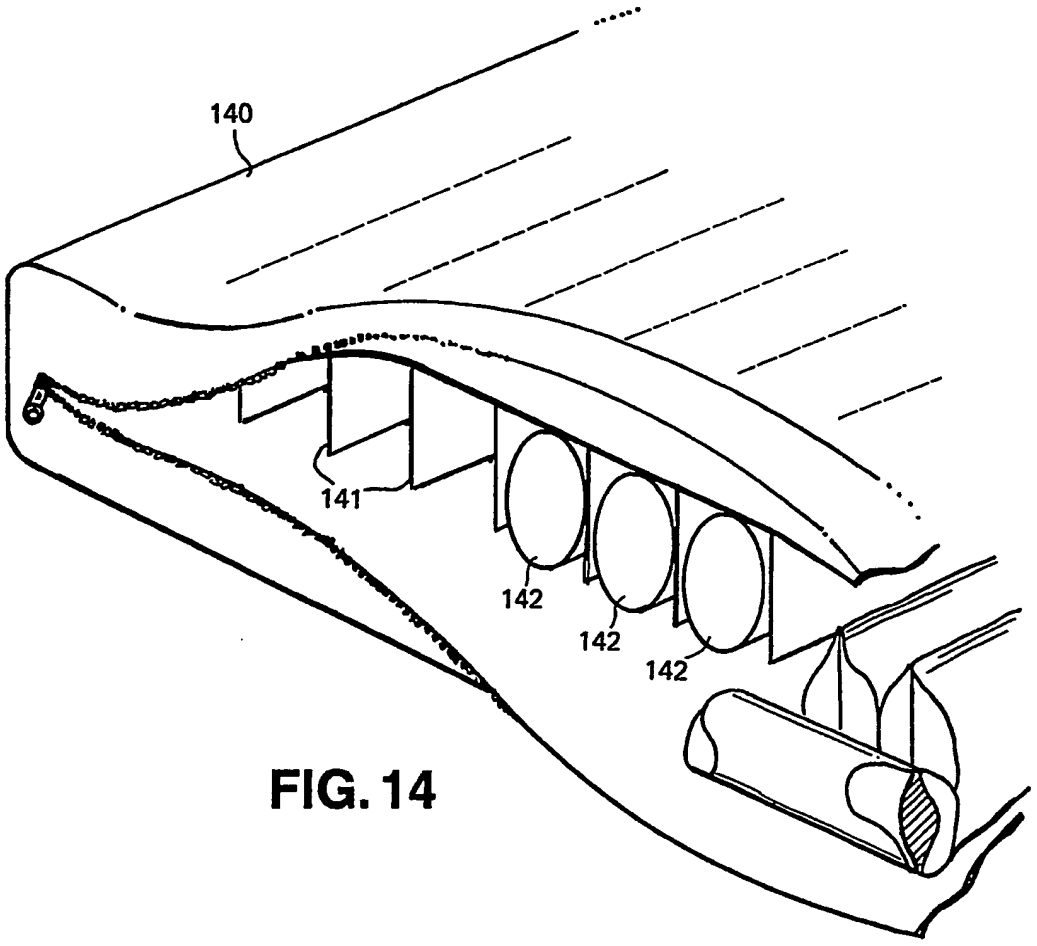


FIG. 14

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IMPROVEMENTS IN OR RELATING TO AIR SUPPORT SYSTEMS

The present invention concerns improvements in or relating to air support systems, and particularly to multi-pressure air support systems. In one aspect, the present invention relates to an air support system additionally including a forced ventilation system. In another aspect, the present invention relates to an air support system including multi-pressure zone air sacs. In certain situations, both aspects of the present invention can be used in combination.

The present invention has particular application in relation to air support systems utilised in the medical field, more particularly support systems such as a bed, pillow, cushion, chair or seat which incorporate an air support system, such as a plurality of air-tight air sacs or chambers. However, it is to be understood that the force ventilated support and the multi-pressure air support systems of the present invention, can also be utilised in connection with other air support systems, for example sun beds and the like.

It is well known in medical circles that low pressure air support systems are rated very highly in providing pressure relief to patients and elderly people who are at risk in developing pressure sores particularly, when confined to a bed for a long period of time.

There are various air support systems known including low loss air support systems, alternating pressure systems and static inflatable devices. There is particularly known a support apparatus comprising a frame with support members being mounted on such frame and a plurality of inflatable air sacs mounted on and

operatively connected to such support members. Such beds usually have a low pressure air supply connected thereto, the pressure normally utilised being of the order of 25 mm Hg. The air sacs or air chambers are almost airtight with leakage at a planned rate from holes or stitch holes and may be linked together to form common pressure zones. Such arrangement enables differing pressures to be applied to the differing groups of air sacs or chambers so as to provide a patient with a comfortable support system. Moreover, the frame is in the form of sections, the angles of which may be adjusted to assist in the comfort of the patient.

Whilst such air support systems are well known and utilised in medical circles, the provision of totally air-tight sacs or chambers, particularly when grouped close together, do not allow for ventilation and can cause a patient to perspire heavily and become uncomfortably hot.

It is one object of the present invention to provide an air support system utilising one or more air-tight sacs or chambers, preferably linked together to form common pressure zones, together with an additional forced ventilation system, the combination being formed into a complete support system which may be in the form of a bed mattress or a seating support system.

According to one aspect of the present invention there is provided a forced ventilated support system, comprising an air support means together with a forced ventilation means.

In an embodiment of such aspect of the present invention, the air support means is in the form of a mattress or support surface as described above having a

plurality of inflatable air sacs or chambers, such mattress or support surface having built into the walls of the air sac or chambers, or as separate pads or jets inserted between adjacent air sacs or chambers, a forced ventilation means in the form of a separate forced air supply whereby air is released from apertures provided in the walls of the sacs or chambers or from apertures provided in the interspaced pads or jets to provide a ventilating air stream to carry away the perspiration from the patient. In addition, the body temperature of the patient can be controlled by either heating or cooling of the forced air supply as required.

The force ventilated support system according to a first aspect of the present invention has various advantages over the prior art, one distinct advantage being that the system of the invention is fail-safe and will not collapse when the power supply fails, the system continuing to support the patient as normal until resumption of the power supply takes place.

It will thus be seen that in a first aspect of the present invention, in one embodiment thereof, a force ventilated air support system is provided having a triple membrane arrangement, two of said membranes providing an air-tight inflatable air chamber or sac and the third, outer, membrane being connected at its edges to the edges of one of said other membranes, and having apertures therein to enable air to be forced out through said apertures.

It has been found that such aspect of the present invention enables a low interface pressure between the body of a patient and the support system to be achieved. Utilising a Texas Interface Pressure Evaluator, it has been ascertained that an interface pressure of a bed

incorporating a support system in accordance with the present invention provides an interface pressure of the order of 16-22 mm Hg, dependent on patient weight and physical characteristics.

In addition to being suitable as a support system for a bed, it is also possible to incorporate the force ventilated air support system of a first aspect of the present invention into a pillow for utilisation with a hospital bed. The pillow may have half its thickness filled with normal filling material and an inflatable core. Such core would be formed of a triple membrane arrangement as referred to above having apertures in the outer membrane. The two membranes forming the air-tight chamber or sac is firstly inflated to the required pressure. In this connection, the thickness of the pillow can be increased or decreased as desired by inflation of the airtight inner core. The pillow may be piped into the air supply system of the bed with which the pillow is being utilised and fresh air is then forced through the apertures in the outer membrane providing the required ventilation through the pillow. Such arrangement assists in preventing perspiration in the neck and head region of a patient.

Whilst the first aspect of the present invention has been described in connection with medical apparatus, it is also believed that the force ventilated air support system of the present invention could be utilised with various seating arrangements, such as car seats. In this connection, the base and the back of the seat could be divided into sections to provide the necessary support and then air would be blown continuously through the apertures or perforations in the leather or like outer covering. Accordingly, a ventilated system will be provided the temperature of which could be controlled

depending upon the time of the year the vehicle was being used. It will be possible to utilise a 12 volt pump which could be mounted in the car to provide the necessary air supply.

According to a further aspect of the present invention there is provided a multi-pressure air support system comprising an air support means together with multi-pressure zone means.

The multi-pressure air support system of such further aspect of the present invention can be utilised in connection with the forced ventilated support system forming the first aspect of the present invention. However, it is to be understood that the present invention can also be utilised with any other type of air support system.

The purpose of providing multi-pressure zones is to enable a greater degree of accuracy and fine control for the support of patients, for example, on inflatable support mattresses such as the zero air loss force ventilated support system as described in accordance with a first aspect of the present invention, a low air loss system as well as independent sac support air systems.

The provision of two or more pressure zones or strata provides a safety higher pressure lower level, combined with a low interface pressure and high comfort upper level.

It will thus be seen that in an embodiment of this further aspect of the present invention, wherein the air support means is in the form of a mattress or support surface, a multi-pressure zone system is provided therein which enables one portion of the mattress or support

surface to operate at one pressure and another position to operate at a differ nt pressure. Accordingly, depending upon the illness and/or injury suffered by a patient, the pressure of the support mattress or support surface can be modified along its length to provide extra comfort for a patient. It is believed that the present invention will have particular use in connection with providing pressure relief to patients and elderly people who are at risk in developing pressure sores, particularly when confined to a bed for a long period of time.

Whilst this further aspect of the present invention has been particularly described in relation to use with a medical support mattress, it is also believed that the multi-pressure zone air support system of the present invention could be utilised with other forms of seating arrangements.

The present invention will be further illustrated, by way of example, with reference to the accompanying drawings, in which Figs. 1 to 8 relate to a first aspect of the present invention and Figs. 9 to 14 relate to a further aspect of the present invention.

The basic principle of the zero loss force ventilated support system aspect of the present invention is illustrated in Fig. 1 which shows a series of air sacs or chambers 10 connected together in pressure zones 11. Such zones 11 are inflated or deflated by means of the inflation nozzle 12. The zones 11 remain at the presure so set via the inflation nozzle 12 using air from a load support air supply into the common manifold 13 via the zone inflation nozzle 12.

A stream of ventilation air is provided via the

ventilation air stream supply nozzle 14 to all the sacs 10 in common via the ventilation air stream supply manifold 15. The ventilation air stream is then evenly distributed along the full surface of the support system via air sac jets 16. In this connection, each air sac 10 preferably has a triple membrane form, two of said membranes forming an air-tight chamber into which air is supplied by means of manifold 13. The outer membrane of the sac 10 provides a space into which the ventilation air stream is supplied via manifold 15. The ventilation air stream then flows out of the air sac jets or apertures 16.

The system illustrated in Fig. 1 shows parts of a mattress system incorporating ventilation air stream apertures and is constructed in the manner indicated above.

Fig. 2 shows an alternative method of assembly utilising plug and socket means to connect the air sac and ventilation channels to the associated manifolds.

Fig. 3 shows another alternative method of air sac connection via plug and socket means.

Whilst the force ventilated system of the first aspect of the present invention can be provided as a simple support mattress or seating unit, the system will be now illustrated in combination with a typical full hospital style or nursing home bed unit as shown in Fig. 4. In such arrangement, the support system of the present invention is mounted on a rigid bed frame 41 having a hinged support top surface 42 by which means the angles and posture of the mattress surface can be adjusted. The power to adjust the angles or posture of the hinged support surface 42 is provided by an

inflatable head bellows 43 and foot bellows 44. The control of the bed angles or posture is available to the patient or nursing staff by means of a hand control push button unit 45 such that when the button to raise the head end of the bed is pressed, air from the air unit 46 is diverted to supply air to the bellows unit 43 and when the push button to lower is pressed, air from bellows 43 is released to atmosphere, thus allowing the bellows 43 to lower the head section of the bed.

Air pressure to the air sac or chamber pressure zones 47, 48 and 49 are controlled in a similar manner to the head and foot bellows 43 and 44, using push buttons on the hand control unit 45.

The ventilation air stream is flowing continuously whenever the pump unit 46 is running via the ventilation air stream supply line 50 to the common ventilation air stream manifold 51 for distribution along the bed surface via the ventilation air jets 16.

The hand control unit 45 has two push button control valves for each operation required of the bed or seating unit. Air from the pump unit 46 passes continuously through the control unit 45 and then through ventilation air stream supply 50 whilst the push buttons are non-active. When a button is pressed to supply power air to inflate or elevate a bed section, the continuous ventilation air stream supply 50 is temporarily cut off and directed via the button pressed to the appropriate bed section requiring air supply. When the button is released, the bed section so inflated is automatically sealed off and the air supply is restored to the ventilation air stream 50. When the push button to deflate a bed section is pushed, air from the section is released to atmosphere until the button is released.

The deflate push button does not effect the ventilation air stream flow 50. A simple air controlled bed unit is illustrated in Fig. 5 having a portable air pump unit 52 which can be connected to any of the bed inflation points as needed to adjust pressure in the pressure zones via a plug and socket type connector in the load support air supply manifold 13 and when pressure adjustments are complete the pump unit 52 is connected to the ventilation air stream supply manifold 15.

A similar system of inflation and deflation control is utilised in the seat unit illustrated in Fig. 6, the seat and back unit illustrated in Fig. 7 and the seat, back and leg unit illustrated in Fig. 8.

It will thus be seen that the force ventilated support system in accordance with the first aspect of the present invention enables additional assistance to be provided to a patient or user of a device incorporating such support system, the force ventilated arrangement enabling the patient or user to remain comfortable.

It is clear that the various integers of the force ventilated support system of the first aspect of the present invention can be formed from any suitable type of materials and modifications can be utilised in connection with the load support air supply system and the ventilation air stream system, whilst still falling within the scope of the present invention.

The embodiment illustrated in Fig. 9 shows a mattress assembly 90 having a multiple section manifold whereby groups of air sacs 91 may be controlled collectively in strata and pressure zones. In this connection, the zones are arranged in groups horizontally and vertically in strata.

In a preferred embodiment, the lowest strata level 92 would be quite firm, whereby the patient on the bed would not, und r any circumstances, be able to sink through the lowest strata level which would be quite firm, whereby the patient on the bed would not, under any circumstances, be able to sink through the lowest level and thereby touch the bed base. On the other hand, the upper level pressure would be set so that the patient is allowed to sink into the upper surface 93 and suitably be suspended just above the surface of the lower level. Further adjustment could be effected to provide maximum comfort in the full confidence that the patient could never reach the bed base through the lower level.

In a preferred embodiment, the horizontal upper strata zone pressures would be set to give typical settings as follows:

Upper body	Medium pressure	10-18 mm/Hg
Mid-section	Higher pressure	15-22 mm/Hg
Foot section	Low pressure	3-8 mm/Hg

Of course, it is to be understood that the pressures selected in the various sections of the mattress will be dependent upon patient weight and physical features.

Fig. 10 illustrates an airtight sac system in accordance with the further aspect of the present invention, but which does not require the ventilation air stream of the first aspect of the present invention.

It can thus be seen that a mattress or the like air support system can be made utilising a plurality of one or more air-tight membranes. Whilst the embodiment of Fig. 10 shows three pressure zones, 101, 102, 103, it is to be understood that any selected number of pressure

zones can be provided. Moreover, as indicated above, the mattress can be made so as to be utilised with or without a forced ventilation air flow.

The embodiment illustrated in Fig. 11 indicates that independent internal pressurised devices or members 112 can be inserted into an air sac 111 and can be used, with or without internal air-tight membranes, so as to create pressure zones within pressure zones, as well as strata pressure zones. Thus, one can provide an inflatable member which is locatable in the air sac and which, in use, will act in a similar manner to the invention by providing multi-pressure zone air sacs.

Fig. 12 illustrates a section of a low air loss support system sac 120, into which has been incorporated a nominally air-proof membrane 121 which has been perforated by the provision of carefully graded holes 122, thereby allowing air to pass through the membrane at a controlled rate relative to the air losses through stitch holes in the upper half of the sac. Such holes may be replaced by an adjustable valve or pressure regulator 123 built in to the membrane or by a separate feed nozzle from the air supply 124. The arrangement of Fig. 12 makes it possible to adjust the pressure in the upper part of the sac to a lower pressure than that in the lower part of the sac. This type of control is suitable for use with twin nozzles or single nozzle low air loss support systems.

Fig. 13 diagrammatically illustrates a single pressure element bed 130, viz, in which the whole sac is at one pressure. Fig. 13 also shows the bed to be divided, along its length, in three pressure zones 131. 132, 133. Each zone comprises a group of sacs and the zones or sac groups are arranged so that different parts

of the body can be supported at the optimum pressure setting to give lowest interface pressure and maximum comfort.

It can clearly be seen that if the bed had only a single continuous zone which was at one pressure throughout its length, then the pressure generated by the weight of a patient would be common throughout. In effect, this would mean that unduly high pressures would be transmitted to areas such as the heels, which would be at the same pressure as at the mid-section. Thus, for example, if a pressure of 20 mm/Hg was present under the mid-section 132, this would also apply 20 mm/Hg to the heel section 133. On the other hand, with a multi-zoned air pressure system of the invention, the pressure applied to the heel section 133 would typically be of the order of 3-8 mm/Hg.

It is to be noted that the arrangement of the horizontal pressure zones can be extremely important and can be utilised in any multiple form depending upon the special effect required.

Fig. 14 schematically illustrates a multi-pressure air support system in accordance with the further aspect of the present invention incorporated within a mattress cover 140. The upper surface of the mattress is usually water vapour permeable to prevent soiling, but will allow perspiration to pass through and to allow for surface washing. As illustrated, the interior of the mattress cover has vertical dividers 141 across the bed attached to the bottom and top sides of the mattress cover.

Again as illustrated, the inflatable sac elements 142 pass between the vertical dividers 141 and are

therefore loosely held in place whilst at the same time being separated from one another. This arrangement allows the sacs to move easily but at the same time be retained in their allotted space even when the sac is less than half full of air and is accordingly quite flaccid.

The control of the semi-inflated sac elements 142 referred to above is generally to prevent the sacs from being pushed apart when a patient is restless on the bed and prevents the patient from falling between the sacs to land or bottom out on the bed frame.

It will thus be seen that the multi-pressure zone air support system in accordance with the further aspect of the present invention enables the pressure in an air support system to be varied along its depth and/or length. In the case of a mattress, as indicated above, it can clearly be seen that a patient can be made far more comfortable by the use of multi-pressure zone air sacs than with a bed at a constant pressure.

It is clear that the various components of the multi-pressure zone air support system of the further aspect of the present invention can be formed from any suitable type of materials and modifications can be utilised in connection with the manner in which the multi-pressure zone arrangement is achieved, whilst still falling within the scope of the present invention.

CLAIMS

1. A force ventilated support system comprising an air support means together with a forced ventilation means.

2. A force ventilated support system as claimed in claim 1 in which the air support means is in the form of a mattress or like support surface having a plurality of inflatable air sacs or chambers.

3. A force ventilated support system as claimed in claim 2, in which said mattress or like support surface has built into the walls of the air sacs or chambers, or as separate pads or jets inserted between adjacent air sacs or chambers, a forced ventilation means in the form of a separate forced air supply, whereby, in use, air is released from apertures provided in the walls of the sacs or chambers or from apertures provided in the interspaced pads or jets to provide a ventilating air stream.

4. A force ventilated support system as claimed in claim 3, in which heating or cooling means are provided for heating or cooling the forced air supply.

5. A force ventilated support system as claimed in any one of claims 1 to 4, in which the system is in the form of a triple membrane arrangement, two of said membranes providing an air-tight inflatable air chamber or sac and the third, outer, membrane being connected at its edge to the edges of one of said other membranes, and having apertures therein to enable air to be forced out through said apertures.

6. A force ventilated support system as claimed in

any preceding claim, in which the system is incorporated into a pillow f r utilisation in a hospitable bed.

7. A force ventilated support system as claimed in claim 6, in which the pillow has half its thickness filled with filling material and air inflatable core.

8. A force ventilated support system as claimed in claim 7, in which the core is formed of a triple membrane arrangement as claimed in claim 5 having apertures in the outer membrane.

9. A force ventilated system as claimed in any one of claims 1 to 5, in which the system is utilised in a car seat, the base and back of the seat being divided into sections to provide the necessary support, apertures or perforations being forced in the outer cover of the seat, through which, in use, air is blown continuously.

10. A force ventilated support system, substantially as hereinbefore described with reference to Figs. 1 to 8 of the accompanying drawings.

11. A multi-pressure air support system comprising an air support means together with multi-pressure zone means.

12. A multi-pressure air support system as claimed in claim 11, in which the air support means is in the form of a mattress or like support surface, and a multi-pressure zone system which enables one portion of the mattress or support surface to operate at one pressure and another portion to operate at a different pressure.

13. A multi-pressure air support system as claimed in claim 12, in which the mattress assembly has a multiple

section manifold in which groups of air sacs are controlled collectively in strata and pressure zones, the zones being arranged in groups horizontally and vertically in strata.

14. A multi-purpose air support system as claimed in claim 13, in which the lowest strata is firm and the upper strata is at a pressure which is at a lower pressure than is the lowest strata.

15. A multi-purpose air support system as claimed in claim 11, in which the air support means is in the form of a mattress having a plurality, preferably three, of pressure zones in the form of air-tight membranes.

16. A multi-purpose air support system, substantially as hereinbefore described with reference to Figs. 9 to 14 of the accompanying drawings.

atents Act 1977
Examiner's report to the Controller under Section 17 (The Search Report)

Application number
GB 9311[redacted]5

Relevant Technical fields

(i) UK Cl (Edition L) A4M

(ii) Int Cl (Edition 5) A47C 27/10

Search Examiner
M J PENNELL

Databases (see over)
(i) UK Patent Office

(ii)

Date of Search
21 JULY 1993

Documents considered relevant following a search in respect of claims 1-10

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2212058 A (NIKKI) - see eg Figures 1,2,7	1 at least
X	GB 2167293 A (MATSUSHITA) - see Figures	1 at least
A	GB 1474018 (WATKINS/WATSON) - see Figure 1	
X	GB 1341325 (SCALES) - see Figures	1 at least
X	GB 1162896 (MAUCH) - see Figures	1 at least
X	EP 0275618 A (AIR PLUS) - see eg Figure 3	1 at least
X	EP 0206152 A (ANTOLINI et al) - see Figures (numeral 62)	1 at least

Category	Identity of document and relevant passages	Relevant to claim(s)

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